CONTENT

- Introduction
- Areas of research
- Cost Analysis
- Benefit Analysis
- Cost/Benefit Analysis
- Conclusion
Expansion of the technologies for the smart grid management

Integration of the separate systems into a unique management system:

- Optimal usage of energy resources
- Management of renewables
- Losses reduction
- Outage time reduction
Smart Grid Management?

- SCADA
- DMS
- AMI
- OMS
- EMS
- DERMS
- UMS
AREAS OF RESEARCH

Potential solutions using UMS:

1. High expenses of normal operation:
   a) Repairs and maintenance
   b) Losses
   c) Penalties

2. Expensive investments in network development

3. Poor supply quality and voltage profiles

4. Strict regulator rules

- Smart commanding
- Optimal topology
- Fast and efficient outage management
- Smart planning tools
- Operation optimisation
- Performance indices improvement
COST ANALYSIS

Real costs of UMS implementation

1. Software licenses
2. Hardware
3. Labour services
4. Taxes

Considering two main variables:

- Complexity of the solution (scope)
- Number of electrical consumers (meters)

Typical project duration 1-2 years
COST ANALYSIS

Analysis Results showed the range per meter to be: 3-10 €/meter

From this range, the average value was taken: 7 €/meter

![Cost Analysis Chart]

- Number of consumers < 100k
- Average value
- Number of consumers > 1.5M
COST ANALYSIS

All additional costs during 10 years of operation were considered:

- System maintenance
- Periodical system updates and upgrades

Total average cost: 2 €/meter/year
BENEFIT ANALYSIS
Using UMS software, particular benefits were analysed:

- Technical losses reduction – using optimisation functions
- Normal operation cost reduction – using outage management applications
- Voltage profiles improvement – using Volt/Var Optimisation
- Investment postponement – using smart planning tools

Results were compared with the real utilities experiences
TECHNICAL LOSSES REDUCTION

Optimisation functions:

- Network reconfiguration – optimal topology
- Volt – Var Optimisation – voltages and reactive power flow management

Final results presented in percentages of the total annual energy transferred through the system: 0.5%

Experience of the utility in Italy (>30M consumers): technical losses reduction for 4% annually, 0.5% of the annual transferred energy
Outage time reduction means more delivered energy

UMS applications for outage management:

- FLISR (Fault Location, Element Isolation, Supply Restoration)
- OMS (Outage Management System)

+ UMS reduces the number of switching operations and prolongs the equipment lifecycle

Energy Savings due to outage time reduction: 1%.

Experience of the utility in Texas (0.5M consumers): energy savings ~1% annually
Volt Var Optimisation with the following optimisation criteria:

- Demand reduction (reduction of the peak demand)
- Minimisation of the voltage deviations (voltage profiles improvement)
- Energy Efficiency

Energy savings due to demand peak reduction: 0.5%.

The experience of the utility in North Carolina (1.5M consumers): Volt Var is operating in closed loop and reducing the demand peak for about 300MW (3%), resulting in savings of about 0.5% of the total annual transferred energy.
INVESTMENT POSTPONEMENT

Investment postponement with UMS:

- Operation optimisation
- Smart planning of the network development

Experiences and possibilities with UMS tools were observed

Average annual savings of the annual transferred energy through the system: 1%

Experience of the utility in Serbia (200k consumers): savings in value of the 1% of the annual transferred energy
## BENEFIT ANALYSIS

- Total benefits overview:

<table>
<thead>
<tr>
<th>Benefit type</th>
<th>Method</th>
<th>Savings of the total annual transferred energy (%)</th>
<th>Annual savings per meter (Eur/consumer/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy losses reduction</td>
<td>Network Reconfiguration, Volt/Var Optimisation</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Normal operation expenses reduction</td>
<td>OMS, FLISR</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Voltage Profiles improvement</td>
<td>Volt Var Optimisation</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Investment postponement</td>
<td>Optimisation functions Planning tools</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total benefits</strong></td>
<td></td>
<td><strong>3 %</strong></td>
<td><strong>6 Eur/consumer/year</strong></td>
</tr>
</tbody>
</table>
Finally, the evaluated costs and benefits were compared:

- Costs: 2 Eur/consumer/year
- Benefits: 6 Eur/consumer/year
- Profitability: 3 times!

In order to increase the sensitivity of the analysis, total costs and benefits, over the project lifecycle were analysed considering the average depreciation rate:

- Total costs: 14.4 Eur/meter/10 years
- Total Benefits: 44 Eur/meter/10 years
- Profitability: 3 times!
BENEFIT ANALYSIS

Standard economic cost/benefit factors:

<table>
<thead>
<tr>
<th>Economic profitability factors</th>
<th>Short explanation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitability factor</td>
<td>describes the profitability of the project</td>
<td>3 times</td>
</tr>
<tr>
<td>Payback time</td>
<td>presents the time in which initial investment will return, and the project becomes profitable</td>
<td>3,3 years</td>
</tr>
<tr>
<td>Return on Investment (ROI)</td>
<td>describes the added value (benefit), which project will bring in the lifetime, over invested amount</td>
<td>2 times</td>
</tr>
<tr>
<td>Internal Rate of Return (IRR)</td>
<td>shows how much the investment is attractive comparing with the average rate of the capital</td>
<td>57.8 %</td>
</tr>
</tbody>
</table>
CONCLUSIONS

The subject of analysis:

- Implementation costs
- Potential benefits

Costs and expected benefits were compared, the results point out that:

- High profitability rate: returned money is three times bigger than the investments
- Short period of the investment return: the entire investment is returned in the first third of the project lifecycle
- High income: income after returned investments are two times bigger than the investment

- Results have shown that UMS is a very attractive investment, showing high profitability and low payback time!
THANK YOU

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